EXPLANATION

OF THE

OCULAR HARPSICHORD,

Upon SHEW to the PUBLIC.

Invento exoritur docto geminata Voluptas,
Affiniſque Sono naſcitur, ecce! Color. AM.

LONDON:

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[Price Six-pence.]

MVSEVM
BRITAN:
NICVM

EXPLANATION

OF THE

OCULAR HARPSICHORD.

The explanation of this new inſtrument will be divided into two parts: The INVENTION *and the* EXECUTION.

PART the FIRST.

The INVENTION *of the* OCULAR HARPSICHORD.

THE inventor of this mathematical machine, who alſo firſt projected the execution of it, was the Father Lewis Bernard Caſtel, a jeſuit, born at Mompellier, who conſtantly almoſt reſided at Paris, at the college of Lewis Le Grand, where he died the 9th of January laſt (1757) aged ſixty years and odd.

This Father was very well known in the Republic of letters, having rendered himſelf famous by ſeveral works in the mathematics, natural philoſophy, and the *belles lettres*. He it was who diſcovered the ſecret of printing pictures, or of graving in colors: and what does him alſo much honor, is the excellent education he gave to the count of Mallebois, whom he uſed to call his

maſter-piece. He had taught him with great ſucceſs the theory of the military art, and grounded him in the true principles of it.

But what contributed moſt to make the Father Caſtel known all over Europe, was the idea he gave of an Ocular Harpſichord. As he was extremely well verſed in the theory of colors, whether according to the ſyſtem of Newton or of Deſcartes, and had a paſſion for muſic, of which he poſſeſſed perfectly the theory throughout all its branches, mathematical and harmonic muſic, and the nature of ſounds, he imagined that if colors could be made to play, and that an inſtrument could be framed, which ſhould, like the Harpſichord, have its tones and demi-tones, its tonics, and quints, *&c.* this variegated play of colors would have an effect on the eyes ſomewhat approaching to what the ſounds have on the ears. I have heard him ſay, that preciſely at the time when that idea firſt ſtruck into his head, Monſieur Rameau came into his apartment, to whom he communicated his deſign; and that it was not but in conſequence of a long converſation they had on this ſubject, that he determined to make an eſſay of it. He then ſet about executing this new idea, after having fully convinced himſelf, by his principles, that the thing was poſſible.

In 1730 he made a trial with colored ſlips of paper, maſked with cartridge. I have often ſeen this eſſay at his apartment, handled and conſidered it. An eaſy ſpring, under the ſtreſs of the finger upon the keys of the Harpſichord, raiſed the co-

lored

lored paper above its cover, ſo as to make the color appear and vaniſh like lightening.

This little eſſay made a prodigious noiſe in Paris: every one ran to ſee it; and the Father Caſtel was ſo overwhelmed with the confluence it drew, that he was obliged to ſhut up his apartment, and to lay this attempt by for ſome time.

But as there are never wanting perſons who love to cavil at every thing, it may eaſily be imagined, that ſo extraordinary an undertaking, that had ſomething of whim and paradox in it, drew upon him cenſors and gainſayers from all quarters.

It was objected to him, beſides the impoſſibility of the thing,

'Firſt, That colors could never have the 'ſame effect on the eyes as ſounds have upon the 'ears; becauſe ſounds make ſuch impreſſions, as 'go ſo far as to effect, and ſtir the ſoul, but 'that colors can excite no ſuch emotions.

'Secondly, That the analogy between ſounds 'and colors, was very different from that which 'he ſeemed to conceive in them; and that this 'analogy conſiſted but in the greater or leſſer re-'frangibility of rays, and nothing more.

'Thirdly, That a note could never be divided 'but into nine ſounds, and thoſe very weak, very 'ſmall, and hard to be underſtood, or diſtinctly 'heard; but that a color might be divided into, 'or generate more than thirty or forty ſhades, all 'very diſtinct and eaſy to be perceived by the eye. 'That he might then make a Harpſichord out of 'one ſingle individual color, differently ſhaded as

as well as one out of the 'as

'well as one out of the twelve primitive or mediating colors.

'Fourthly, That the ſounds ſtriking the ear either ſimultaneouſly or ſucceſſively, had their conſonances or diſſonances, but that colors (here are not meant the black or white, but only the primordial ones) could never form any conſonances, or rather that they have neither conſonances nor diſſonances.

'Fifthly, That three colors ſtarting at once, can never unite together in the eye, ſo as to form one ſingle individual color, as three ſounds uttered at once and ſtriking the ear, form but one ſingle individual ſound: that this difficulty is ſuch an obſtacle, as he can never ſurmount, and which muſt overſet his whole ſyſtem.

'That then, properly ſpeaking, there could be neither melody nor harmony in his new inſtrument; no melody, becauſe that requires diſſonances mixt with conſonances; no harmony, becauſe three different colors ſtarting at once, can never form a ſingle one, compoſed out of the three, *&c. &c.*'

Notwithſtanding theſe objections, which are very ſtrong ones, and were made by perſons who poſſeſt a reputation not leſs eminent than that of the Jeſuit, (amongſt whom I cannot but tremble to name Meſſieurs Buffon, and De Mairan) the Father Caſtel ſtuck to his ſyſtem; defending it with much ſagacity and genius, and anſwered his gainſayers with great life and ſpirit.

His anſwers may be ſeen in five long letters, upon this ſubject, printed in 1735, and addreſſed to the preſident Monteſquieu.

The

The Father Caſtel, anſwers in the firſt place, ‘ that there is no judging by the eſſay he had made, ‘ whether the thing was poſſible or impoſſible: ‘ this eſſay being nothing in compariſon to the ‘ machine he propoſed making: that if any thing ‘ was impoſſible, it would be the execution of his ‘ inſtrument, and not the effect that would reſult ‘ from the play of the colors. For that,

‘ Firſt, he did not pretend to work an effect ‘ upon the eyes that ſhould penetrate the mind, ‘ as the ſounds do which enter in at the ear; and ‘ that it is true that the ſenſe of ſight, though the ‘ moſt extenſive; is yet with reſpect to the ſenſations it excites in the ſoul, one of the moſt ‘ limited, as it affects it the leaſt; that he pretends ‘ to produce no other effect upon the eye, than to ‘ entertain it agreeably, to ſurprize and dazzle it.

‘ Secondly, That he did not deceive himſelf by ‘ conceiving any other analogy between ſounds ‘ and colors, or other agreement than what is ‘ apprehended by the greateſt naturaliſts, whether ‘ they follow the ſyſtem of Deſcartes or the doctrine of Newton, and that with reſpect thereto, ‘ there was nothing new in his idea.

‘ Thirdly, That if colors can be divided into ‘ more degrees, and form more differences, than ‘ what ſounds do, this only ſhews that light ‘ is infinitely more ſubtile than the ſonorous medium or body, and all that proves no more than ‘ that a Harpſichord of colors might be infinitely ‘ more extenſive and varied (without including ‘ the figure of the apertures, through which the ‘ colored lightening eſcapes) than the Harpſichord

of

'of ſounds; and that it is truly on ſuch an Harp-
'ſichord as the Ocular one, that might be played
'the quarters of tones, or enharmonics of which
it is ſaid the Greeks made uſe.* That, for the
'reſt, though a color, as the blue or green, might
'be varied into ſeveral colors of the ſame ſort,
'yet, it is certain, that having drawn from thence
'twelve or thirteen ſenſibly diſtinct ſhades, the
'other ſhades begin to have a remoteneſs, that
'ſcarcely allows of tracing them to the primi-
'tive color from whence they originate.

'Fourthly, That colors have, like ſounds,
'their diſſonances and conſonances; that there-
'fore the objection on this account is a very fri-
'volous one, not to ſay worſe: that without hav-
'ing recourſe to the authority of painters and
'dyers, he needs but appeal to the judgment of
'the ladies, whoſe nice exquiſite taſte, is not at a
'loſs how to find a difference in the aſſortment
'of colors.

'Fifthly, That it is very true, that to judge by
'the eſſay he had made, three colors ſtarting at
'once, could not unite in the eye ſo as to form
'one ſingle individual color, like the unity of three
'ſounds in the ear; but that it is to be obſerved,
'that the three ſounds are already united before
'they reach it, and that ſound being a body ſix
'hundred thouſand times leſs ſubtile than light,
'it is to be ſuppoſed that if the light could not
'mix, or the objects not be blended together in
'the eye, ſounds could leſs yet be mixed and
'blended in the ear, if they were not already ſo

* See Meibomius & Wallis.

'before

‘ before they entered it: that one might then de-
‘ termine a fixed point (this too the cavillers may
‘ treat as a paradox) or a common center that
‘ ſhould be the focus of all the colored glaſſes;
‘ that then three colors ſtarting at once, coming
‘ to unite in one center, would preſent to the eye
‘ one only and individual color; but that ſuch an
‘ undertaking would exact a great deal of care,
‘ pains, and application, and eſpecially a great
‘ expence. That it cannot then be ſaid, that
‘ there will neither be melody nor harmony in his
‘ new inſtrument; that harmony there will be,
‘ is plain, ſince the colors will unite, and offer
‘ only one ſingly to the eye; and that melody will
‘ not be wanting, ſince by ſtriking the keys with
‘ the fingers, thoſe keys will ſucceſſively, and one
‘ after another, ſtart but one color at once, that
‘ will be ſometimes conſonant, ſometimes diſ-
‘ ſonant, *&c. &c.*

The public ſeemed to approve of the Father Caſtel's reaſons; and his anſwers were no ſooner red, than that ſeveral perſons of the higheſt diſtinction offered to advance him the neceſſary ſums. His excellency the duke of Hueſcar, the Spaniſh ambaſſador, ſent him a thouſand crowns to begin the work. Some years after, the Marqueſs of Mallebois, afterwards Marſhal of France, ſent him two thouſand livres. But whether thro' want of good workmen, or of money, or of œconomy in the diſburſement, the Father Caſtel abandoned his undertaking, and more than twenty years elapſed without any thing more being ſaid of the Ocular Harpſichord.

In

In the mean time, the bare idea he had given to the public of this ſort of Harpſichord had deſerved to him the commendations of ſeveral academies, and of a great number of men of letters. The Royal Society of London admitted him one of the members that compoſe that illuſtrious body: the academies of Toulouſe and Bourdeaux claimed him, and inſiſted on his being one of their ſociety. An academician of Peterſburgh, in the diſcourſe pronounced on an opening of that academy after a vacation, ſpoke of this new invention, in the moſt honorable terms, for the Father Caſtel. Monſieur de Voltaire, in ſeveral private letters he wrote to him on this ſubject, beſtows commendations on him, in which truth and politeneſs are united without nauſeouſneſs, and without hyperbole. We ſhall only quote here what Monſieur de Voltaire has printed on this matter in his Elements of Newton's Philoſophy, chap. XIV. p. 227.

An ingenious philoſopher has wanted to puſh this agreement between ſound and light, further than it ſeems allowable for the human underſtanding to go. He has imagined an Ocular Harpſichord, which ſhall make appear ſucceſſively harmonic colors, as common harpſichords propagate ſounds to the ear. He works at it with his own hands; in ſhort, he pretends to play tunes to the eyes. One cannot but think thanks due to a man who thus lays himſelf out to procure to others new arts and new pleaſure. This idea has not yet been executed; and the author did not follow the notions of Newton. In the mean time it ſeems to me, that one cannot too much commend ſuch efforts of genius,

genius, employed in ſeeking to enlarge the career of arts and nature.

Since we are ſpeaking of the inventive genius of the Father Caſtel, it may not be improper to inſert here, what the only two men at Paris, who poſſeſs the ſecret of graving in colors, have ſaid of the Father Caſtel, by way of doing him the juſtice he deſerves on this point. It is mentioned in the courſe of the diſpute thoſe two artiſts had together in the following terms:

Your petitioner (Monſieur Gautier) acknowledges that he is beholden for the theory of this art to the lights afforded him by the Father Caſtel, a Jeſuit, who was the firſt that gave him a hint of it. Monſieur Le Blon has drawn his notions from the ſame ſpring-head. He had owned, in a writing, that he held his ſecret from the ſame Father. See the Mercury of France, April 1756. p. 212.

It was then for above twenty years, as before obſerved, that nothing more was heard of the Ocular Harpſichord. The Father Caſtel himſelf was ſo diſguſted from reſuming this undertaking, either for having twice failed in it, or on account of the jeſts * made of it by his ad-

Some ſaid that the next thing that would be attempted would be landſkapes for the ears; others that it would be an inſtrument for ribbon-weavers, and the like; as what ſo excellent is there that a joke cannot faſten upon it? In a word, the Father Caſtel ſaw himſelf, like the Lyon in the fable, expoſed to all the flings of his cenſors, without the power of eluding them, and a public butt of their witticiſms. There was not even the loweſt ſcribbler but what had his laſh at him.

verſaries, that he refuſed being at the head of a company, who came to offer him ten thouſand crowns to be the chief director of it, on communicating his ſecret and ideas, and obtaining an excluſive patent.

It was not then till the year 1754, in the month of July, that the Father Caſtel reſumed his firſt idea of the execution of his Harpſichord, and this was the occaſion.

I was returning one day from Monſieur de Fontenelle's, when I had been upon ſome private buſineſs, I had there had an occaſion of mentioning Father Caſtel and his Harpſichord. Monſieur de Fontenelle having told me, that he could never well comprehend what Father Caſtel aimed at in it, I endeavoured to explain his ſyſtem to him. Monſieur de Fontenelle, who, amongſt a number of other good qualities, eminently poſſeſs'd that of politeneſs, told me he was very old, that he deſpaired of ſeeing this inſtrument finiſhed, or that it would be a great ſatisfaction to him to ſee it ſucceed, and the age in which he lived enriched before he died with ſo ingenious an invention. I did not fail of reporting to Father Caſtel this my converſation with Monſieur de Fontenelle, and eſpecially the genteel compliment he had made him with reſpect to this Ocular Harpſichord.

'Well then (ſays the Father Caſtel) I am more 'ſenſibly moved with the words of this great 'man, than with all that the great have ſaid 'or done to engage me to put my hand again

to

'to the work, or with all the money that 'ſeveral Farmers of the Revenue have offered 'me upon this account. I forget all that 'my enemies have ſaid or done againſt me. 'I will write this inſtant to the Count of 'Maillebois to ſend me twenty lewidores, and 'will at the ſame time write to Monſieur de 'Fontenelle, that it is purely in honor to him 'that I reſume the undertaking. Do you go 'to-morrow and beſpeak the workmen; you 'ſhall direct them in the work, that I may 'have no noiſe with them; I will not even ſee 'them: I will keep myſelf locked up in my 'cloſet, whilſt you ſhall make them work in 'my apartment, and in the gallery.'

Accordingly, I ſet about engaging the workmen, and buying all the neceſſary materials towards this undertaking. The joiner, the founder, the lockſmith, were all aſſembled and ſet to work. For the firſt days every thing went very well; but the founder having unhappily failed in his operations, the work was diſcontinued, the undertaking ſuperſeded, and adjourned till after the vacations. In this interval, I came to England, ſo that I could not ſee the iſſue of this third eſſay. Yet it was not wholly an unſucceſsful one, to judge of it by the Father Caſtel's letter to me on this ſubject in the month of April 1755, of which I proceed to give an extract, and am ready to ſhew to the curious the original in his own hand-writing.

EXTRACT *of the Father Caſtel's Letter.*

'My Harpſichord had been finiſhed two 'months ago, juſt on the inſtant of this death (that of the preſident Monteſquieu, of which he particularizes an account in this letter.) 'You failed in your trial of Auguſt? Did not 'I tell you that I ſhould get the better, at this 'bout, of my Harpſichord ſcheme? I have 'been toſt from bad workmen to bad work-'men for ſome months. The 18th of De-'cember, it ſeemed to me, that I could 'boldly ſay that the Harpſichord was made. 'I lighted up about five or ſix wax can-'dles; I played; Mr. Rondet, and three or 'four other ſpectators, ſaid, yes, it is made. 'I called in ſeven or eight perſons, and all of 'them ſaid, the Harpſichord is made. The '21ſt, the day of St. Thomas the patron of the 'uncredulous and of the Harpſichord, I gave 'an invitation to fifty perſons of the houſe, 'and from abroad, and lighted a hundred wax 'candles. There was nothing but acclamation 'and clapping of hands in conſequence for the 'ſpace of half an hour that I played, and all 'that compoſed what I called the pit owned 'that the Harpſichord was made, and for ever 'makeable. The moſt incredulous I had in-'vited in part of the number of my fifty ſpec-'tators, and it was preciſely theſe who paid me 'the greateſt compliments upon my ſucceſs, 'whilſt I laughed at their preceding incre-'dulity,

'dulity, and they laughed at it themſelves. 'The ſame day I went into retreat; the ap-'plauſe and noiſe followed me there. Every 'one wanted to ſee, and ſee again this novelty. 'I put them off to New-year's day for a hand-'ſell. The Harpſichord ſtood, as you know, 'before my anti-chamber, and blocking up my 'apartment, in the front of the gallery. Pre-'ciſely at five o'clock, the gallery was full of 'Jeſuits, Abbots, Seculars, of gentlemen and 'ladies. There was the Preſident de Quin-'ſonas, his brother the Commandant, Madam 'the Marſhaleſs of Lowendahl, *&c.* The 'Harpſichord played, and two hundred per-'ſons owned that they had never ſeen any 'thing more beautiful, or more brilliant, and 'all concluded that the Harpſichord was *exe-'cutable*, *poſſible*, *true*, and even *made:* I alone 'aſſuring them, that this was not even a *ſketch*, 'a *beginning* of it, ſo far was it from *perfect*.

'To tell you how I went to work with it, or 'how I propoſe to proceed with it, I ſhall not 'here attempt. You had full opportunity to ſee, 'know, and examine every thing. Since 'thirty years ago, I have, as it were, explained 'every thing to the public. It has not been 'pleaſed to aſſiſt me; and will learn it at its 'own expence. After the invention of the 'thing, the public left entirely upon me the 'invention of its execution. I have now got 'hold of it. I write no longer about it, but 'to ſay that every thing is written. I had

'about

'about fifteen years ago, a thouſand guineas 'promiſed me from England for my executing 'it. I have now done it for fifty. I never 'thought of doing it, but as it were for no-'thing, and I have ſucceeded.

'You bring me back to my A, B, C, when 'you ſend me the liſt of C, C, Sharp, *&c.* I 'will anſwer you better, upon the great queſ-'tions you ſtate to me on the part of your Eng-'liſh young gentlemen. *My aim is to make 'harmony, and almoſt muſic, enter in at the eye, 'as it has hitherto done at the ear. My aim is to 'make harmony as well ſeen as heard. My aim is 'to make a blind man judge of colors, and the deaf 'judge of ſounds. My aim is to repreſent by colors 'all that is repreſented by ſounds. My aim is to 'make ſound as it were, be ſeen at the ſame 'time that it is heard, and to make color be 'heard at the ſame time that it is ſeen.* For this 'purpoſe I join to my Harpſichord or organ 'of colors, an Harpſichord or organ of ſounds. 'By the preſſure of the fingers on the keys, 'one may *ſee* one may *hear* the harmony, and 'what is to be ſeen will be analogous to what 'is heard. When C is heard, *blue* will be 'ſeen: When *red* is ſeen, E will be heard. 'The chiar-obſcuro will anſwer to the grave 'ſharp; with C grave will be ſhewn a *dark 'blue*, &c. All this you know as well as I do.

'I have demonſtrated that there are but 'twelve octaves of harmonic notes poſſible from 'the loweſt ſound to the uppermoſt. I have

'demonſtrated

'demonſtrated the ſame number of colors, 'whether blue, green, red, yellow, &c. In 'muſic the tone is diſtinguiſhed from the 'ſound. I have equally diſtinguiſhed the color 'from the chiar-obſcuro. In all I have de-'monſtrated 12 × 12 = 144 ſounds, from the 'cord of 64 feet to 2½ lines of diameter, and 'ſo many colors from the black to the white. 'All this ſtands demonſtrated in my letters to 'the Preſident de Monteſquieu. Never was 'ſo new an invention ſo fully demonſtrated 'before its execution. It is high time I ſhould 'reap the fruit of the ſucceſs of my labor.

'I am preparing to render an account of 'my Harpſichord, in quality of member of 'the Royal Society. You may aſſure them 'of it by this letter. If the very reſpectable 'Preſident the Chevalier Folkes was alive, 'I ſhould before now have wrote to him 'about it.'

In the 36th of the moral letters, in oppoſition to Monſieur Rouſſeau's on Natural Philoſophy, printed in 1756, of which an extract may be ſeen in the Mercury of the laſt July, p. 148. Father Caſtel thus expreſſes himſelf.

'My Novelties, my Works, my Harp-'ſichord, are novelties in no ſenſe but that 'of an addition to ſciences, to arts, and to 'the ancient muſic. I do not annihilate our 'muſic, the common, the auricular muſic. 'I double muſic in rendering it at once auri-

cular

'cular and ocular; and ſhould I not even 'ſucceed, at the worſt it can be no more, 'than as if I had ſaid nothing: I rob no one 'of his ears. I even aſſiſt all the world with 'eyes, to underſtand and taſte muſic. The 'deaf may attain to ſome conception of auri-'cular muſic by the ſight of ocular muſic; the 'blind of ocular muſic by hearing the auri-'cular; on an explanation of the analogies of 'the one with the other; and thoſe who have 'both eyes and ears, will enjoy each the better, 'for being able to enjoy both.'

MVSEVM
BRITAN
NICVM

PART

PART the SECOND.

The EXECUTION.

THIS is the Harpſichord of which we have juſt treated: but whether it will be well received I cannot take upon me to determine. I am, however, ſo far from deſiring to impoſe on the public, that I am afraid of nothing ſo much, as of over-raiſing its expectations either of curioſity or pleaſure, and am led by this very reaſon to prefix this account of the execution, by which any one may frame an idea of it, juſt enough to hinder his complaining of being at leaſt intentionally by me deceived, ſince all that I dare as yet ſay, is, that this Harpſichord is only made for philoſophical eyes, and that there can be no pleaſure expected to be felt from it, but that which a curioſity for optics and muſic will give to a mind of a philoſophical turn.

This Ocular Harpſichord, to enter into particulars of the pieces that compoſe it, is in form of a beaufet, of the height of five feet eight inches, breadth three feet four inches, and in depth two feet, placed perpendicularly upon the fore part of a common Harpſichord.

The back-board contains in the ſpace of three feet ſquare five hundred and odd lamps, which will form a very briſk light; ſo that the colored lightening will full ſufficiently illuminate the ſhow-room.

The fore-board, that fronts the ſpectators, carries ſixty colored glaſſes, every one analogous or anſwering to the ſound that is to be heard by the ear, at the ſame time that the coloured lightening will act upon the eye. For the ſame touch that produces the ſound will, at the ſame time, ſtart the luminous color. The ſound, as being the leſs ſubtile, will be the firſt put in motion, with proper allowance for the interval; ſo that the ſound may make itſelf heard by the ears, at the ſame inſtant that the light will ſtrike upon the eye.

The colored glaſſes are tranſparent enamels of an elliptic form, of two inches and a half diameter, and cut in ſuch proportion as to form a luminous cone, of which the baſis will be brought to bear on the eye of the ſpectators.

Theſe colors are marſhalled according to Newton's ſyſtem. I have laid aſide that of the Father Caſtel's, who modelled his upon Deſcartes; becauſe I know, by various experiences that I have made on the matter, that the generation of colors, and their analogy with the notes, are truer demonſtrated by the ſyſtem of Newton, than

by that of Deſcartes. Thus the moſt refrangible ray, the violet, anſwers to D, and ſo on.

The Father Caſtel put blue for his tonic, and red for the dominant, founded upon this principle, that blue is the color generative of all the reſt. But this ſyſtem, to which he was ever obſtinately attached, notwithſtanding all the demonſtrations and experiences he had in favor of Newton's ſyſtem, alone coſt him more difficulties to encounter, than all the reſt of his undertaking.

In the colors then will be found all the proportions which the mathematicians find in muſic.

Firſt, The proportion of intervals, or purely the harmonic proportion, that is to ſay, the ſcarlet will be to crimſon as C is to C ſharp, or as 24 is to 25; the crimſon to violet as C ſharp is to D, or as 15 is to 16; the red to violet as C is to D, or as 8 is to 9, and ſo forth.

Secondly, The proportion of the octaves, or the geometrical proportion: ſo that the red of the firſt octave will be to the red of the ſecond, as C grave is to C acute, or as 1 is to 2.

Thirdly, The proportion of harmonic ſounds, or as Wallis calls it, the numerical proportion: that is to ſay, the red will be to the green as the tonic is to the dominant,

or as 2 is to 3; the red to purple as the tonic is to the mediant, or as 4 is to 5, and ſo forth.

In the colors too will be found the three analogies they have with the ſounds.

Firſt, The analogy of refrangibility, with the length of the chords which generate the ſound: ſo that, for example, the refrangibility of the orange color will be to the refrangibility of the red *(inverſa ratione)* as the length of the chord that ſounds B to the length of the chord that ſounds C, and ſo on. It is to Newton alone that the diſcovery of this firſt analogy is owing.

Secondly, The analogy of intervals: that is to ſay, that the ſpace occupied by one of theſe primordial rays is in the ſame proportion as the intervals between the notes; ſo that for example, the ſpace which the orange color takes up, is as the interval between E and F, and ſo forth.

Thirdly, the analogy of momentaneity: for, as Monſieur de Voltaire obſerves, p. 226. in his elements of Newton's philoſophy, 'There 'is yet another agreement between ſounds 'and colors, which is, that the moſt inter-'diſtant rays, the violets and the reds come 'to the eye at the ſame time, and that the 'moſt inter-diſtant ſounds, the grave and the 'acute come alſo to the ear at the ſame time. 'That is not to ſay that we ſhould hear and 'ſee at the ſame time, at the ſame diſtance,

'for

'for the light makes itſelf be perceived conſiderably quicker than ſound. It only means that the blue rays, for example, do not come from the Sun to the eye, ſooner than the red rays, no more than the ſound of the note B comes to our ears ſooner than the ſound of the note D.'

Let any one repreſent to himſelf the difficulties to be overcome, the obſtacles to remove, the pains and attention requiſite to be taken, that the colors and glaſſes ſhall have preciſely no other than the degree of color, or of *focus*, that they ought to have, to preſerve their analogy with the ſounds, and he will find no reaſon to wonder at the Father Caſtel's renouncing this undertaking. Obliged to attend the functions of his miniſtry, he could not but miſcarry in all the eſſays he made, becauſe he could not be always with the workmen to direct their operations. It is not to be imagined the pains that muſt be taken with thoſe people, the attention one muſt have to humor, and even to court them to do what you would have them, beſides the capital part they think they have in your undertaking. If you fail them in any of theſe points, they in their turn will fail you in your work.

The Harpſichord is executed in great, and is indeed as great as it can be for a portable Harpſichord. Smaller ones may be made

made which one ſingle perſon may manage, but they would only be proper for a chamber, but not to make any figure in an audience-room.

I could have given to the apertures, that let the color lightening paſs, different forms and different figures, and for example, have diſpoſed them into any ſubject I might have choſen, and repreſented in lightenings. But this pleaſure is only fit for ſuch as a magic lanthorn could amuſe. I have only ſought in this to ſhew the agreement between ſounds and light, and a philoſophical eye would have been but little affected with the groſs and childiſh pleaſure of figures.

MVSEVM
BRITAN
NICVM

FINIS.